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(54) Abstract Title
Use of motion to input information into a radio telephone

(57) A user of a radio telephone moves the telephone in patterns in order to input characters or select functions. Motion patterns of the user's choice may be assigned to various functions or characters. The telephone may have an accelerometer to detect movement.

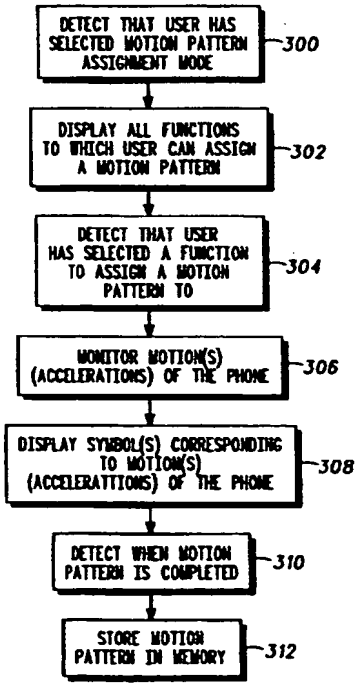

FIG.3

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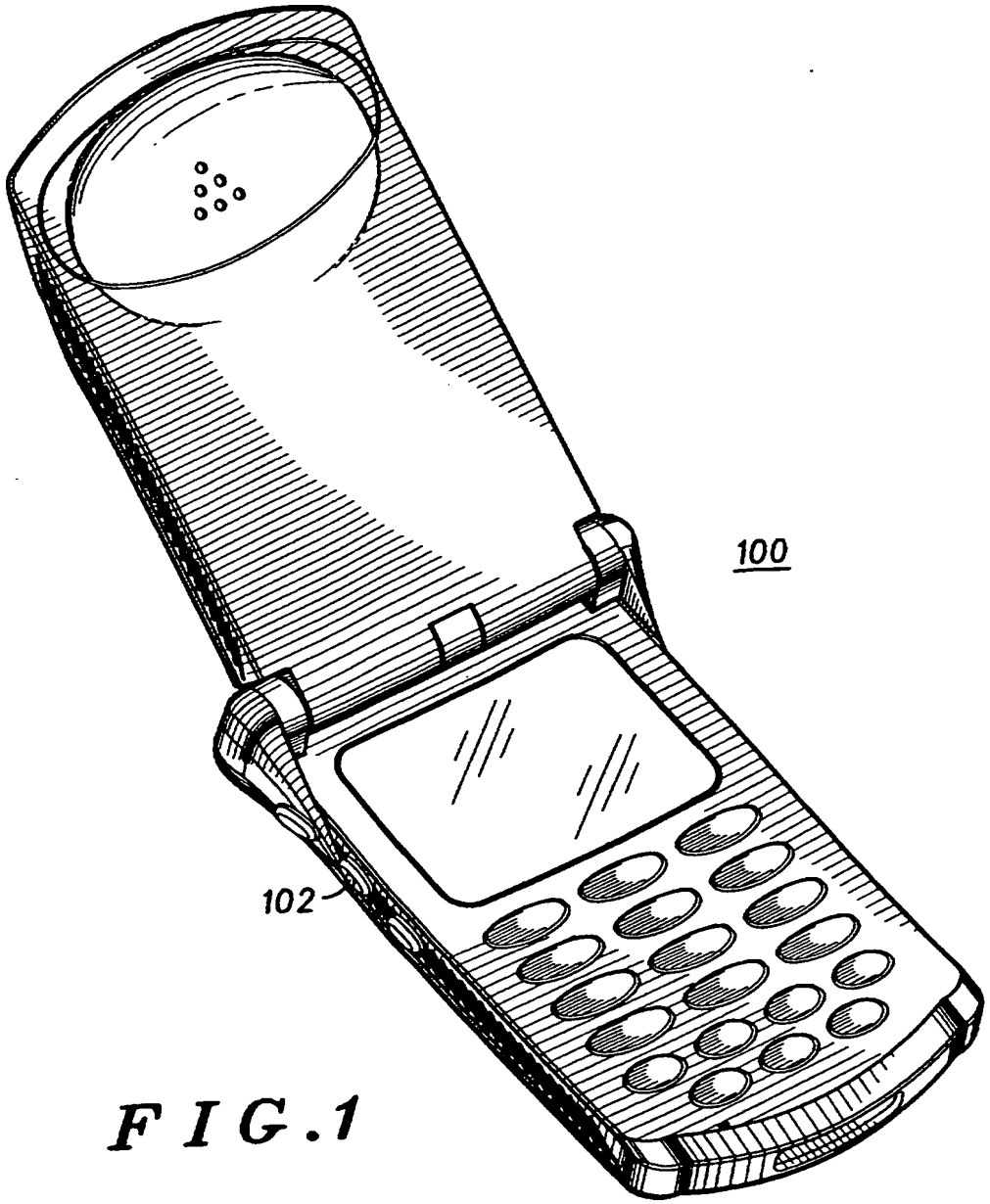


FIG.1

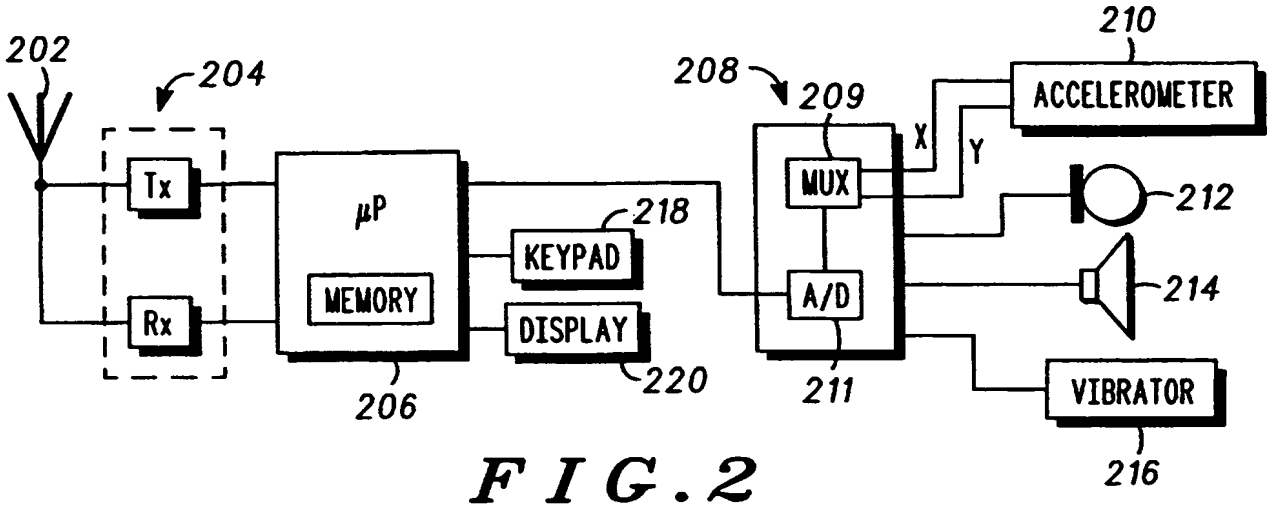


FIG. 2

MOVEMENT IDENTIFIER	MOVEMENT	X ACCELERATION DIRECTION	Y ACCELERATION DIRECTION
1	→	+	0
2	←	−	0
3	↑	0	+
4	↓	0	−
5	↗	+	+
6	↙	−	−
7	↖	−	+
8	↘	+	−

FIG. 5

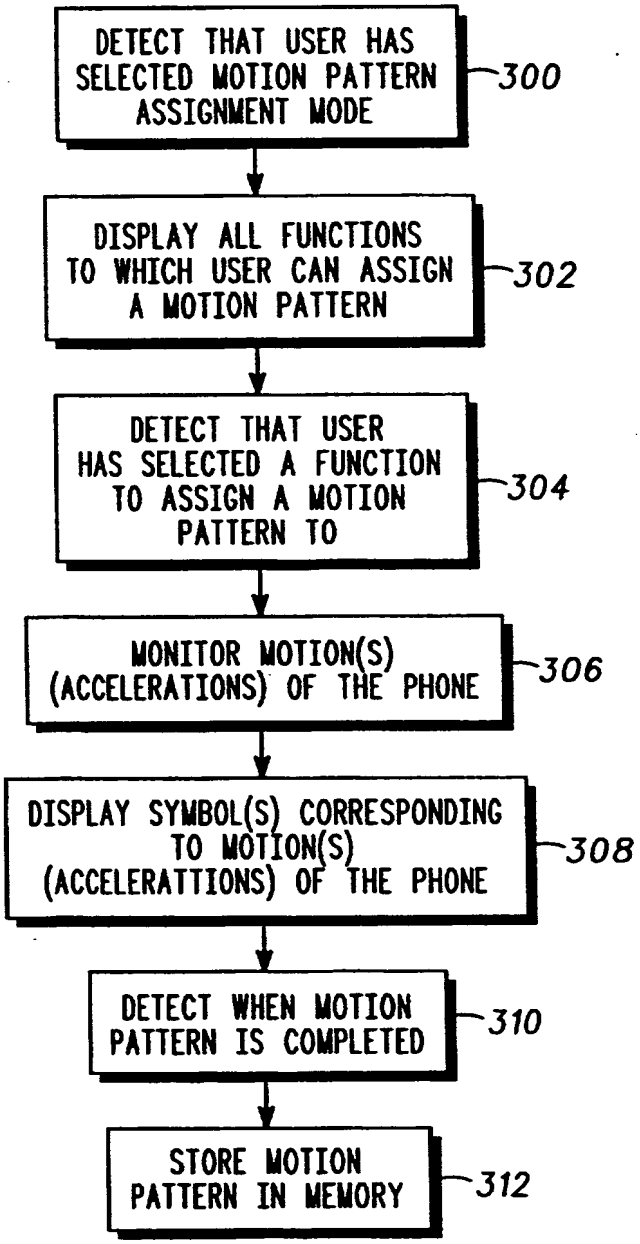
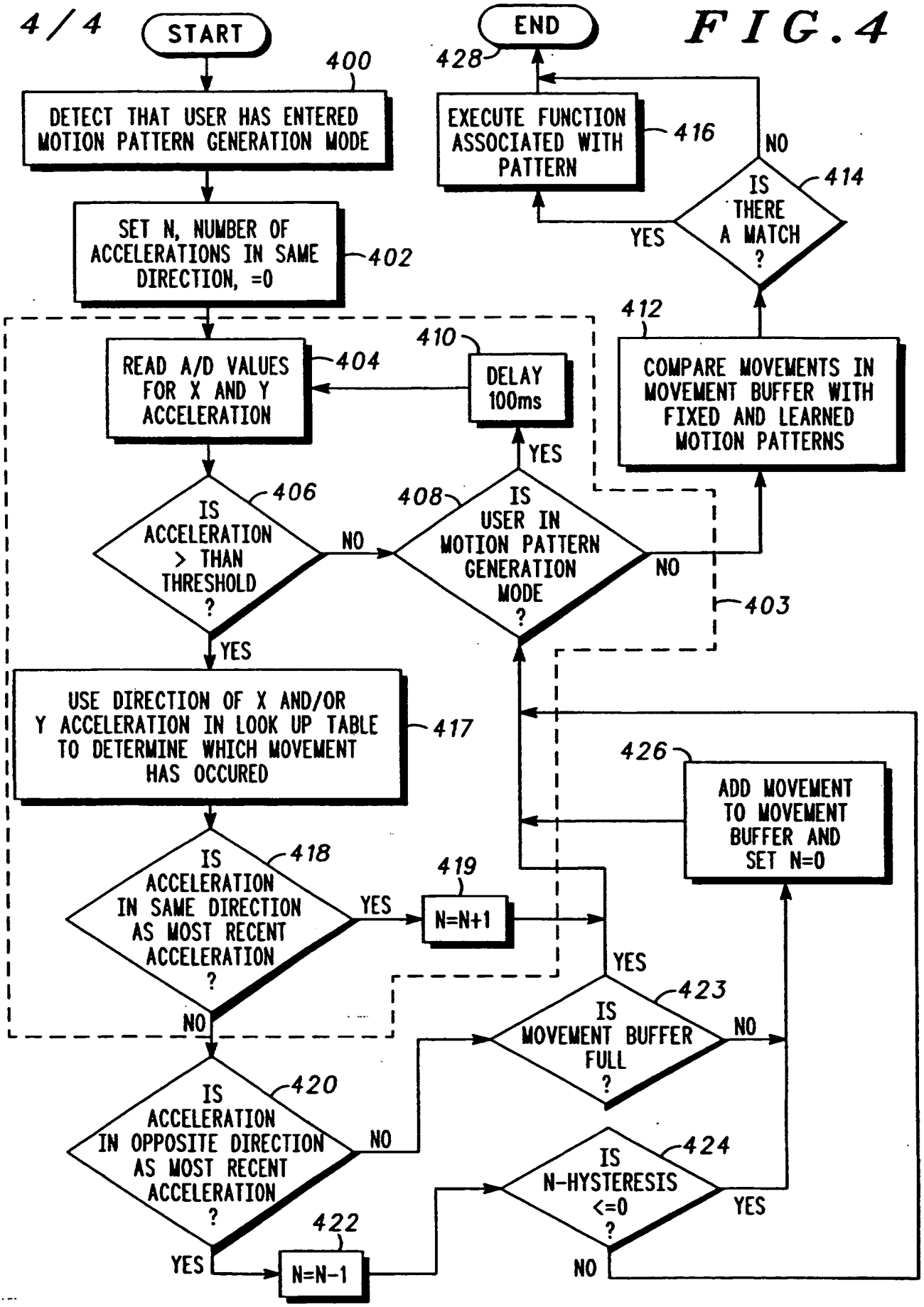


FIG. 3

FIG. 4



APPARATUS AND METHOD FOR USING MOTION TO INPUT INFORMATION TO A WIRELESS COMMUNICATION DEVICE

Field of the Invention

The present invention relates generally to the field of radio communications. More particularly, the present invention relates to an apparatus and method for using motion to input information to a wireless communication device. Although the invention has a wide range of applications, it is particularly suited for use in a radiotelephone, and will be described in that connection.

Background of the Invention

As the size of electronic components continues to decrease, the size of wireless communication devices also continues to decrease. However, the ability to make wireless communication devices smaller is somewhat limited by the competing need to maintain an ergonomic user interface. Consumers have expressed an interest in surfing the web using a wireless communication device, such as a radiotelephone. Virtual displays have potential for use in allowing a user to receive a full screen of information from a small unit, but the user still needs a vehicle for inputting information to the phone. Voice recognition is one input method currently being pursued by several radiotelephone manufacturers. However, depending on the environment, speaking aloud is not always desirable or possible.

Input methods using motion and accelerometers to track the motion are known. However, known methods are complex in that they use the accelerometers outputs to determine the velocity and/or position of the input device. For example, U.S. Patent No. 4747,051 ("051 patent") teaches a hand-held inertial mouse that provides input data to a computer that can determine the translational and angular displacement of the mouse. The mouse uses accelerometer pairs for producing output signals of magnitudes proportional to the translational acceleration of the mouse in three non-parallel directions. The translational velocity and displacement of the mouse is determined by integrating the accelerometer output signals and the angular velocity and displacement of the mouse is determined by integrating the difference between the output signals of the accelerometer pairs. U. S.

Patent No. 5,615,132 describes another apparatus and method for determining position and orientation of a moveable object using accelerometers.

Hall et al. teaches in U. S. Patent No. 5,703,623 ('623 patent) a combination of Hall-effect sensing and thinfilm piezoelectric effect technology to determine single or multiple degrees of freedom within an orientation sensing remote control device. Hall et al. teaches a means for an operator to input to a multimedia video system information which allows the multimedia video system to ascertain position, motion and attitude of the input device in terms of three-dimensional spatial coordinates. Similar to the '051 patent, the '623 patent teaches an input means that requires ascertaining the position and attitude of the input device.

U. S. Patent No. 5,583,478 describes a method for providing a realistic sense of touch in virtual reality by means of programmable actuator assemblies. Each actuator assembly consists of a number of individual actuators whose movement is controlled by a computer and associated drive electronics. The patent peripherally mentions that the actuator has applications as an accelerometer, but does not discuss how an accelerometer can be used.

U. S. Patent Nos. 5,688,183 and 5,733,201 describe systems that use accelerometers to detect the velocity or speed of a golf club.

Thus there is a need for a simplified apparatus and method for inputting information to a device, whereby tracking the velocity and/or position of the input device is unnecessary.

Brief Description of the Drawings

FIG. 1 is a preferred embodiment of a radiotelephone that can implement the apparatus and method of the present invention.

FIG. 2 is a partial block diagram of the radiotelephone illustrated in FIG. 1.

FIG. 3 is a flow diagram of the preferred embodiment of the method of assigning motion patterns to functions and storing them in memory.

FIG. 4 is a flow diagram of the preferred embodiment of the method of interpreting accelerations of the radiotelephone.

FIG. 5 is a look-up table that associates X and Y acceleration directions with movements of the phone.

Summary of the Preferred Embodiment

A first aspect of the present invention provides in a radiotelephone having a memory and a display, a method of assigning a motion pattern to a function performed in the radiotelephone, wherein the method comprises the steps of selecting a mode corresponding to assigning a motion pattern to a function; selecting a function to be assigned to a new motion pattern; building the new motion pattern by moving the radiotelephone in at least one direction; and storing the new motion pattern in the radiotelephone memory.

A second aspect of the present invention provides in a radiotelephone having a memory, a method of detecting motion patterns and performing functions corresponding to the motion patterns, wherein the method comprises the steps of detecting a motion pattern of the radiotelephone; determining whether the motion pattern corresponds to a function stored in memory; and if the motion pattern corresponds to a function stored in memory, performing the function.

A third aspect of the present invention provides a method of notifying a user of a radiotelephone that an event has occurred, wherein the method comprises the steps of detecting the occurrence of an event in the radiotelephone; detecting that the radiotelephone has not moved for a predetermined period of time; detecting movement of the radiotelephone; and notifying the user that the event has occurred.

A fourth aspect of the present invention provides in a radiotelephone that supports alphanumeric entry, a method of using motion patterns to enter alphanumeric characters comprising the steps of selecting a mode corresponding to using motion patterns to enter alphanumeric characters; detecting a motion pattern of the radiotelephone; determining if the motion pattern has been assigned to an alphanumeric character; and if the motion pattern has been assigned to an alphanumeric character, processing entry of the alphanumeric character.

Description of the Preferred Embodiment

The following detailed description is exemplary and explanatory only and is not restrictive of the invention as claimed. The accompanying drawings illustrate the preferred embodiments of the invention and together with the description serve to explain the principles of the invention. Reference will now be made in detail to the presently preferred embodiments of the invention.

Referring to FIG. 1, a radiotelephone 100 that can implement the methods of the present invention is shown. As shown in the block diagram of FIG. 2, the radiotelephone 100 includes an antenna 202, a transceiver 204, a microprocessor 206 including a memory, a power supply IC 208 including a multiplexer 209 and an analog-to-digital converter 211, an accelerometer 210, a microphone 212, a speaker 214, a vibrator 216, a keypad 218 and a display 220. The antenna 202 receives signals from and transmits signals to the transceiver 204. These signals are sent to the microprocessor 206 for processing. The microprocessor also processes inputs from the keypad 218 and sends outputs to the display 220. The microprocessor 206 receives inputs from the A/D converter 211 which receives analog voltages from the accelerometer 210 and coverts the voltages to digital so they can be used by the microprocessor 206. In the preferred embodiment, the output voltages from the accelerometer 210 are coupled to the multiplexer 209 so that one A/D converter can be used. The power supply IC 208 is coupled to the microphone 212, speaker 214, and vibrator 216 to control the power supplied thereto.

Preferably, the accelerometer 210 is an Analog Devices 2-axis MEMS (micromachine) based accelerometer, part number ADLX202, commonly available from many sources. The accelerometer 210 outputs two voltages, one for each axis X and Y, centered around approximately mid supply. As the radiotelephone is accelerated (or moved) +/- X, +/- Y, or a combination thereof, the voltages on the two lines increase or decrease from the DC voltage point. In the table of FIG. 5, the acceleration direction values provided for X and Y correspond to the direction of the voltage variations of the accelerometer 210 outputs. For example, if movement of the radiotelephone causes the X accelerometer output voltage to increase from the DC voltage point, there is movement in the "X" direction and the

acceleration in the X direction is positive (+). If movement of the radiotelephone causes the X accelerometer output voltage to decrease from the DC voltage point, there is movement in the "X" direction and the acceleration in the X direction is negative (-). If there is no movement of the radiotelephone in the X direction, the X accelerometer output voltage does not vary and there is no acceleration (0) in the X direction. The same holds true for the Y accelerometer output voltage.

The remainder of the circuitry shown in FIG. 2 can be implemented using commonly available components known in the art. Since these aspects of the radiotelephone are not directly relevant to the instant invention, no further details are provided herein.

In the presently preferred embodiments, the microprocessor 206 monitors the accelerometer output voltages X and Y to implement various input methods according to the present invention. Unlike known devices that utilize accelerometers for input methods, the microprocessor 206 of the present invention monitors acceleration changes only. In the present method, knowledge of the absolute or relative location of the phone, or the current velocity of the phone is unnecessary. Therefore, no integration of the acceleration is required.

The preferred embodiment of the method of using motion to input information into a radiotelephone 100 involves the steps of assigning motion patterns to radiotelephone functions such as lock the phone, unlock the phone, speed dial, scrolling through memory, etc. Once the motion patterns are assigned and stored in memory, the user can move the phone 100 in a particular predefined pattern and the phone 100 will automatically perform the assigned function. In the alternative, the radiotelephone 100 could be manufactured with pre-stored motion patterns that correspond to or can be assigned to particular functions. Before using a stored motion pattern to perform a function, the user first enters a motion pattern generation mode. In the preferred embodiment, the user enters this mode by pressing and holding a button 102 (FIG. 1) located on the phone's exterior. When the button 102 is pressed and held, the microprocessor 206 monitors the X and Y accelerations as the user moves the phone 100, thereby generating a motion pattern. Once the button 102 is released, indicating that the motion pattern is

complete, the motion pattern is compared to the patterns stored in memory. If there is a match, the microprocessor 206 causes the phone 100 to perform the function corresponding to the stored pattern.

Using the principles described above, motion patterns can also be used to generate alphanumeric characters in a radiotelephone 100. For example, once the motion pattern is input to the phone, assigned to an alphanumeric character(s) and stored in memory, the user can move the phone 100 in the predefined pattern to generate the corresponding alphanumeric character(s).

Motion can also be used as input to a radiotelephone 100 to notify the user of receipt of an event after the phone has been motionless for a predetermined period of time. For example, if the radiotelephone 100 having short message service capability receives a message and the microprocessor 206 determines that no X or Y acceleration has been detected for a predetermined period of time since receipt of the message, upon receiving an indication that the phone has been moved, the microprocessor 206 can send a message to the speaker 214 or vibrator 216 to alert the user of the message. Such an alert could periodically be provided by the microprocessor until the short message is acknowledged. This notification function can be particularly useful for clam shell style phones where the display is typically hidden when the phone is not in use. Without the function, the user would be required to open the clam shell to notice that a message has been received.

The flowchart in FIG. 3 illustrates the preferred embodiment of the method of assigning motion patterns to functions and storing them in memory. In block 300, the microprocessor detects that the user has selected to enter the motion pattern assignment mode. In block 302, the microprocessor displays all functions to which the user can assign a motion pattern. After the user has selected a function, the microprocessor, in block 304, detects the selection. As the user moves the phone, thereby defining the motion pattern, the microprocessor in block 306 monitors the motions (accelerations) of the phone, and preferably displays symbols corresponding to the motions to the user (block 308). In block 310, the microprocessor detects when the motion pattern is completed, and in block 312 stores the motion pattern in memory.

The flowchart in FIG. 4 illustrates the preferred embodiment of the method of how the microprocessor software interprets the accelerations of the phone. First, the microprocessor detects that the user has entered the motion pattern generation mode (block 400). In the preferred embodiment, this is accomplished by the user pressing and holding a button on the radiotelephone. Next, in block 402, the microprocessor initializes a variable n, representing the number of accelerations of the phone in the same direction, to zero. The microprocessor reads the X and Y acceleration values from the A/D converter (block 404). If the acceleration values are not greater than a threshold value, the processor determines whether the user is still in the motion pattern generation mode (decision block 408). If yes, the microprocessor delays for a period of time (block 410) and repeats the process starting with block 404. If the user is no longer in the motion pattern generation mode, the microprocessor compares motions in a movement buffer with fixed and learned motion patterns (block 412) and determines whether the buffered patterns match any of the fixed and learned motion patterns (block 414). If yes, the function associated with the pattern is executed (block 416) and the method ends (block 428). If no, the method ends (block 428).

Referring back to decision block 406, if the acceleration values are greater than the threshold, indicating that an acceleration has actually occurred, the microprocessor uses the direction of X and/or Y acceleration in the look-up table of FIG. 5 to determine which movement has occurred (block 417). Next, in decision block 418, the method determines whether the acceleration is in the same direction as the most recent acceleration. If yes, the microprocessor increments variable n and proceeds to decision block 408 discussed above. If no, the microprocessor determines whether the acceleration is in the opposite direction as the most recent acceleration (block 420). If yes, the microprocessor decrements the variable n (block 422) and determines whether the variable modified by hysterisis is less than or equal to zero (decision block 424). (The hysteresis allows detection of a reversal in motion versus a cessation of motion without integrating the acceleration to determine velocity.) If no, decision block 408 is executed. If yes, indicating a reversal in the motion direction of the phone, the microprocessor adds the

movement to the movement buffer, resets variable n to zero (block 426), and executes decision block 408.

Referring back to decision block 420, if the acceleration is not in the opposite direction as the most recent acceleration, the microprocessor determines whether the movement buffer is full (decision block 423). If yes, the maximum number of motions has already been stored and the method proceeds to decision block 408. If no, the motion (acceleration) is added to the movement buffer and variable n is reset to zero.

An example of how the flowchart of FIG. 4 can be used to unlock the radiotelephone 100 is now described. In the current example, a "Z" motion pattern corresponding to the "unlock phone" function is stored in memory. (As explained later, movements 1, 6, 1 in the look-up table of FIG. 5 define the "Z" motion pattern.) In block 400, the microprocessor detects that the user has entered the motion pattern generation mode. Next, in block 402, the microprocessor initializes the number of accelerations to zero. After the user accelerates the phone, corresponding to the first movement ("1") of the "Z" motion pattern, the microprocessor reads the X and Y values from the accelerometer 210 (via the MUX 209 and the A/D converter 211). Next, the microprocessor 206 determines whether the acceleration is greater than a predetermined threshold to ensure that an acceleration in fact took place (decision block 406). If the acceleration is greater than the threshold, the method determines from the X and Y acceleration directions that the current movement is the movement corresponding to movement identifier "1" in the look-up table in FIG. 5 (block 417).

Next, the method determines whether the acceleration is in the same direction as the most recent acceleration (block 418). Since, this is the first acceleration that has taken place, the answer is "no" and the method proceeds to block 420 to determine whether the acceleration is in the opposite direction as the most recent acceleration (block 420). Since the answer is still "no", the method proceeds to block 428 to determine whether the movement buffer is full. At this point in the method, the movement buffer is not full, so the method proceeds to block 426. In block 426, the method adds the movement (corresponding to movement identifier "1") to the movement buffer and sets n = 0. Next, the method checks whether the user

is still in the motion pattern generation mode (block 408). If yes, the method delays, preferably for 100 ms (block 410), and then proceeds to block 404 to repeat the process.

If the user is still in the process of performing the first movement, the answer to decision block 418 is "yes" and the method proceeds to block 419 to increment n. The method remains in loop 403 as long as the user is performing the first movement. When the user begins the next movement of the "Z" motion, the answer to decision block 418 is "no" and the method proceeds to decision block 420. In block 420, the method determines that the second movement of the "Z" motion is not in the opposite direction of the first movement, so the method proceeds to block 422 to check whether the movement buffer is full. If the movement buffer is not full, the method stores the second movement of the "Z" motion in the movement buffer, resets n to zero and proceeds to block 408. The method continues as described earlier until the third movement of the "Z" motion is completed and stored in the movement buffer. At that point, the user exits the pattern generation mode and the method compares the movements in the movement buffer to the motion patterns stored in memory (block 412). If there is a match, the function associated with the motion pattern is executed (block 416) and the method ends (block 417).

Those skilled in the art will recognize that various modifications and variations can be made in the apparatus of the present invention and in construction of this apparatus without departing from the scope of this invention.

CLAIMS:

1. In a radiotelephone having a memory and a display, a method of assigning a motion pattern to a function performed in the radiotelephone, the method comprising:

placing the radiotelephone in a mode corresponding to assigning a motion pattern to a function;

detecting that a user has selected a function to be assigned to a new motion pattern;

detecting the new motion pattern created by the user;

assigning the function to the new motion pattern; and

storing the new motion pattern in the radiotelephone memory.

2. The method of claim 1 wherein the step of storing the new motion pattern in the radiotelephone memory first comprises the step of comparing the new motion pattern to motion patterns already stored in memory and storing the new motion pattern in memory only if the new motion pattern is different from the other motion patterns already stored in memory.

3. The method of claim 2 wherein if the new motion pattern matches one of the motion patterns already stored in memory, displaying a message notifying a user that the new motion pattern is not unique.

4. The method of claim 3 further comprising the step of requesting that the user enter another motion pattern after displaying the message notifying the user that the motion pattern is not unique.

5. The method of claim 1 wherein the step of detecting the new motion pattern created by the user further includes the step of displaying at least one symbol representative of the motion pattern to the user.

6. In a radiotelephone having a memory, a method of detecting motion patterns and performing functions corresponding to the motion patterns comprising the steps of:

detecting a motion pattern of the radiotelephone;

determining whether the motion pattern corresponds to a function stored in memory; and

if the motion pattern corresponds to a function stored in memory, performing the function.

7. The method of claim 6 further comprising the step of providing an error indication to a user if the motion pattern does not correspond to a function stored in memory.

8. In a radiotelephone having a memory and a display, a method of assigning a motion pattern to a function performed in the radiotelephone, the method comprising:

placing the radiotelephone in a mode corresponding to assigning a motion pattern to a function;

detecting that a user has selected a motion pattern from a list of pre-stored patterns in the memory;

assigning a function to the selected motion pattern to produce a function-motion pattern pair; and

storing the function-motion pattern pair in memory.

9. A method of notifying a user of a radiotelephone that an event has occurred, the method comprising the steps of:

detecting the occurrence of an event in the radiotelephone;

detecting that the radiotelephone has not moved for a predetermined period of time;

detecting movement of the radiotelephone; and

notifying the user that the event has occurred.

10. In a radiotelephone that supports alphanumeric entry, a method of using motion patterns to generate alphanumeric characters comprising the steps of:

detecting that a user has selected a mode corresponding to using motion patterns to generate alphanumeric characters;

detecting a motion pattern of the radiotelephone;

determining if the motion pattern has been assigned to an alphanumeric character; and

if the motion pattern has been assigned to an alphanumeric character, generating the alphanumeric character.

The Patent Office

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Application No:	GB 0000101.6	**Examiner:**	Glyn Hughes
Claims searched:	1 to 8, 10	**Date of search:**	29 June 2000

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H4L (LEUF), H4K (KBKX)

Int Cl (Ed.7): G06F 3/033, H04M 1/247, 1/725, H04Q 7/32

Other: Online: WPI, JAPIO, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X, P	GB 2329300 A	(NOKIA) see in particular page 5 lines 4 to 26	10
X, P	WO 99/46909 A1	(ULLMAN) see whole document	10

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.